

23.

The Nesting Behavior of *Eupomotis gibbosus* (Linnaeus)
In a Small Pool.

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(Plates I & II; Text-figures 1 & 2).

INTRODUCTION.

A general study of the nesting behavior of the family Centrarchidae has already been given in this journal (Breder, 1936). The present contribution is based on a continuation of these studies on one species, *Eupomotis gibbosus* (Linnaeus), and compared with other studies on a very different type of fish, *Ameiurus nebulosus* (Le Sueur), under an identical situation (Breder, 1939).

In the spring of 1940 fourteen mature *Eupomotis* were placed in a pool on the writer's property. This pool has been described in detail by Breder (1939), and its general form may be seen in Text-fig. 1. Due to an unusually hard freeze the *Ameiurus* which occupied it the previous year were all frozen out, although the *Rhodeus amarus* which shared the pool with them survived. Thus the pool, in addition to being physically similar, was also alike in the organisms present in addition to those under study.

The *Eupomotis* were collected from the lake in Central Park, New York City, at 59th Street, as part of a considerable number taken to the New York Aquarium. These fish were in their second year and were 10 cm. long. The chief purpose of the experiment was to note the number of nests constructed in a given body of water by a known number of fish and to compare their behavior with that of the previously studied *Ameiurus*. It was impossible to determine the numbers of each sex with certainty or to keep track of each individual fish under the conditions of the experiment.

REPRODUCTIVE SCHEDULE.

Pre-spawning Behavior.

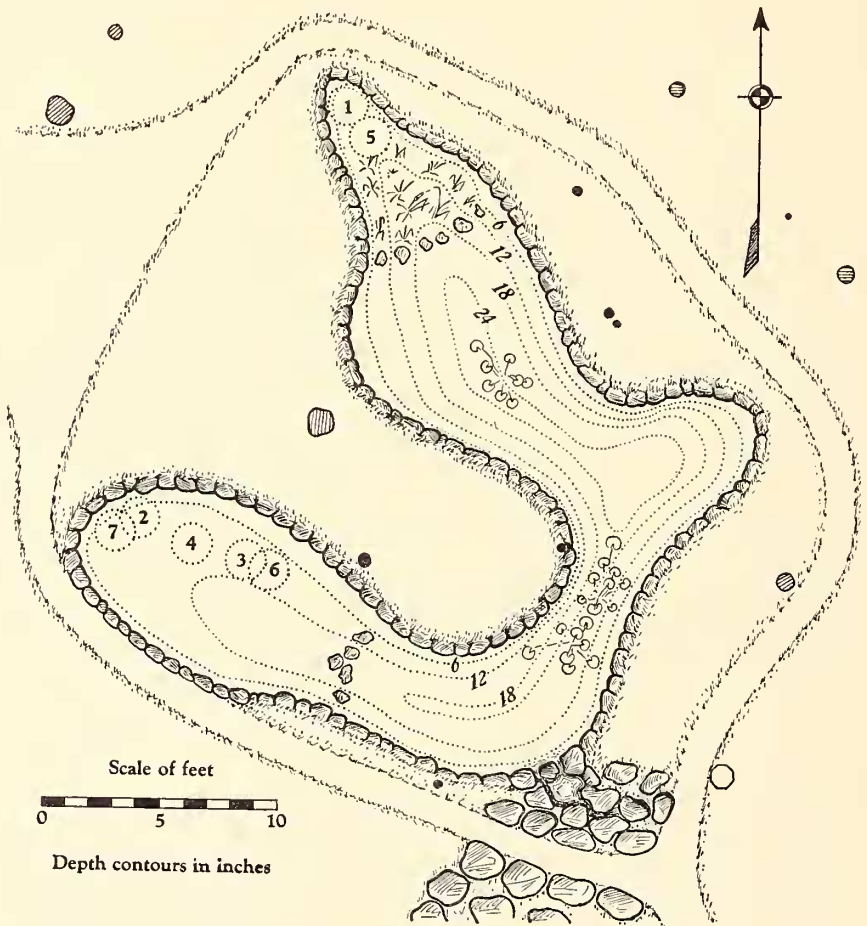
The fish were released on May 5 when the water was about 18.5° C. As they began nesting on May 18, by which time it had reached 20°, there was not much time for observation of the pre-spawning behavior. After a few days of accommodation and exploration, the fish settled in a school in or over the deepest part of the pool, near the water lilies in the north arm, rising to near the surface on sunny days and staying in the deeper parts at night and on dark days. Here they remained for the most part, with occasional short sallies to other places until nest construction began. Those fish not engaged in this activity continued to behave in a similar manner except that as the season advanced they moved from the northwest part of the 24'

contour to the southeast. Much later a group of four or five was frequently seen in the southwest extension of the 18" contour which reaches into the southwest arm of the pool.

Nest Construction.

In all, seven nests were excavated, and since there were fourteen fish it is tempting to assume that the sexes were equally divided and that each male built one nest. It is doubtful if such is actually the case, however, as there is reason to believe that some of the males built more than one nest, as will be shown subsequently.

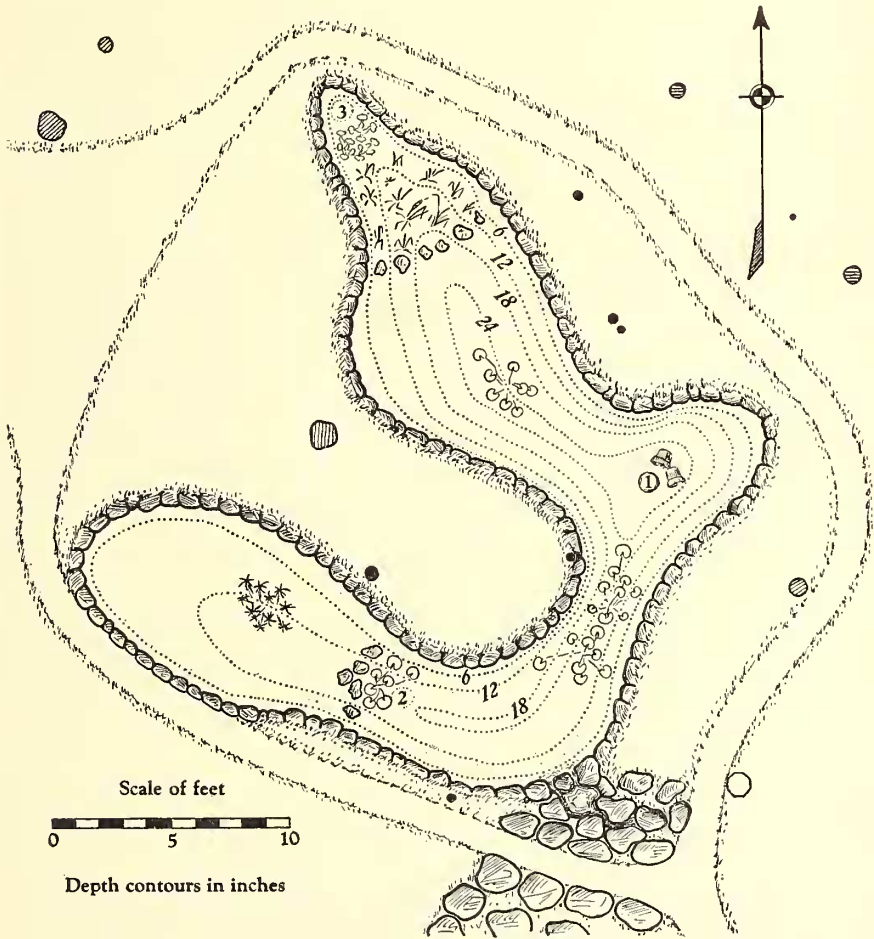
The nests are numbered in Text-figure 1 in the order of their construction, which gives a measure of order of choice of locality. Considered this way, there were actually only three major choices, since nest 6 and nest 7



Text-figure 1.

Sketch map of the pool in which the present studies were made. The circled numbers, 1 to 7, indicate the nests of *Eupomotis* in the order constructed. The contour lines indicate the depth of water in inches. See text for explanation.

encroached on the older nest 3 and 2 respectively. While nest 5 did not encroach on nest 1, it closely approached it; but nest 5 was built while there were eggs in nest 1. Nest 4 split the distance between nest 2 and nest 3, but we have reason to believe that 2 and 4 were made by the same fish, as they were alternately worked by one male. Thus it is apparent that the only available areas suited to these fish in this pool are in the upper tips of the two arms. The contour lines show why this should be so, for at all other places the shore line is too steep for sunfish to build nests, and apparently under the conditions in this pool they seek water between 6" and 12" in depth. The gravel bottom made nesting a simple matter of cleaning off such fine detritus as might be present. Not much of a "dish" could be formed as the large size of the gravel precluded much shifting by the efforts of these small fish.



Text-figure 2.

The nests of *Ameiurus* of the previous year in the same pool. (After Breder, 1939). The circled numbers, 1 to 3, indicate the catfish nests in the order constructed. Differences in the symbols for aquatic plants, et cetera, indicate the only changes in the pool between the two years. See text for explanation.

TABLE I.
Schedule of Events in Reproducing *Eupomotis*.

| Dates | NEST NUMBER. | | | | | | | EVENTS. | TEMPERATURE °C. | |
|---------|--------------|----|-----|----|---|---|----|--|-----------------|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | AIR | WATER |
| May 5 | | | | | | | | 14 fish placed in pool. | | |
| 18 | B | | | | | | | Nest just begun. | 23.0 | 20.0 |
| 19 | | B | | | | | | Nest begun. | | |
| 20 | | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | A | A | B | | | | | Nest begun. | | |
| 25 | | | (1) | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | 25.3 | 20.0 |
| 28 | | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | | RC | A | | | | | Nest #2 reoccupied, courting vigorously. | | |
| 31 | | | | | | | | | | |
| June 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | RE | | | | | | | Nest reoccupied, eggs. | 25.8 | 24.8 |
| 5 | (2) | A | | | | | | Eggs hatched. | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | RC | | | | | | Nest reoccupied, courting. | 24.8 | 24.8 |
| 9 | | | | BC | | | | Nest begun, courting. | 24.0 | 25.3 |
| 10 | | | | | | | | | | |
| 11 | | | | | | | | | | |
| 12 | | | | | | | | | | |
| 13 | E | | | | | | | 2d eggs, young on nest. | | |
| 14 | L | | | | | | | Young left nest. | | |
| 15 | | | | | | | | Absent from locality—observations suspended. | | |
| July 14 | A | A | Y | A | A | A | A | Young on nest #3. Nests #5, 6 and 7 made during absence and abandoned. | 22.5 | 21.0 |
| 15 | | | | | | | | | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | | | | | | | | | |
| 19 | | | | | | | | | | |
| 20 | | | L | | | | RE | Young left nest #3. Nest #7 reoccupied and spawning. | 26.5 | 21.3 |
| 21 | | | A | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | | | | | | | | | | |
| 26 | | | | | | | | | | |
| 27 | | | | | | | | | | |
| 28 | | | | | | | | | | |
| 29 | | | | | | | | | | |
| 30 | | | | | | | | | | |

A Heavy storm this date.

A—nest abandoned. B—nest begun. C—courting. E—eggs present. H—eggs hatched. L—young fish left nest. R—nest reoccupied. Y—young on nest.

(1)—Plate I taken this day.

(2)—Plate II taken this day.

If Text-figure 1 is studied closely it will be seen that the presence of nest 1, because of the conformation of the shore, bottom and plants, precluded another nest in that entire arm except very close to it. The next nest, 2, was built as far from it as the pool allowed, being in the other arm. The third nest, now that the other arm was occupied, also was built in the southern arm and as far from nest 2 as the depth permitted. A consideration of the bottom contours and the desire of these fishes to pick the sunniest places well accounts for this and the preceding positions. With this restriction, the only remaining place for a nest not in contact or encroaching on another is that site on which nest 4 was constructed. After this there remained no other place available in the pool in which a nest could be built remote from one already constructed. In fact, the only remaining place where overlapping was not necessary was that place selected for nest 5 which was peripheral to nest 1.

When construction had reached this point no further nests could be built in the spaces available except along the south shore of the south arm. This place was apparently entirely out of the question because of shade. The two remaining nests, 6 and 7, were consequently made so close to 3 and 2 respectively that they encroached on the latter as shown. Table I gives the time sequence of these events.

Courting Activities.

An interesting note on the courting activities of these fish was made June 8 on nest 2. Here a female approached and was very vigorous, entering the nest voluntarily and circling the male and nudging the exposed gravel with her snout. She was not feeding but seemed in a high state of sexual excitement. It gave the impression that the activities of the male are largely one of indicating his presence and willingness and of indicating the location of the nest, the female actually doing the "selecting." It would seem that the chasing of females by males is of that nature rather than a matter of "driving" the female over the nest as is usually reported. The latter would seem to be an impossible procedure with all the open water normally available to these fishes. Usually the male is so willing to spawn that this feature is not seen. For some reason this male did not seem to be ready or able to perform his part and finally the female departed.

On June 9 a single male attended both nest 4 and nest 2. While he spent most of his time on the new nest, he did give attention to both, and a tentatively approaching female caused him to display over both, depending on which one she happened to be nearer. At this time another male attempted to reoccupy nest 3, presumably its maker which had abandoned it some time before, but was driven off by the extreme vigor of the proprietor of nests 2 and 4. Nevertheless no eggs resulted from this activity.

Effects of Weather.

As is well known, the activity of sunfish is considerably controlled by temperature and light. This was very evident as may be noted in Table I by the frequent "Abandonments" and "Reoccupations" of nests. In late May and early June there was an unseasonable amount of cloudy weather and chilly days. It is reflected in the activity and lack of activity indicated in this table. That these factors do not completely control sunfish activity is indicated by the lack of exact synchronization of behavior. For example, on May 24 two nests were abandoned and a third begun. Presumably these

vagaries in behavior have to do with variations in the physiological impetus of the various individuals. When fish abandoned their nests they rejoined the general school which would normally have been composed of females alone.

The last nest was abandoned on July 30, on which date a heavy wind and rainstorm did violent local damage, including the felling of a tree across the pool.

Attention to Eggs and Young.

It is certain that at least three of the nests produced young, that is, nest 1 (two batches), nest 3 and nest 7. Later in the season young of four different size groups which corresponded to the spacing of these four hatchings were evident. What happened during the period of personal absence is not entirely clear but family reports indicate that there was no further egg production.

Nest 1, the first to be established and perhaps therefore by the most vigorous male, had at one time both eggs and young of very different ages in the nest. The young left the nest the day after new eggs were deposited. While it is known that sunfish will spawn on repeated days with a number of females, the writer had not previously encountered or seen reports on two batches of such a difference in age.

DISCUSSION.

Compared with the nesting dates on this species recorded by Breder (1936) for the same general region, the present dates agree very well. His early date was May 11, the present May 18; his late date August 14, the present July 30.

The depths selected by the size of fish involved agree perfectly with his Figure 2. The diameters of the nests, about 20 cm., fall in the Pines Lake group of that paper which also happens to be the closest geographically. It will be noted that in the south arm of the pool, the only place where any selection was possible, the nests are ranged along its northern edge, which is what should be expected since the other side is shaded by the south bank. Normally one expects sunfish nests on the north side of a small pond for this reason, as has already been discussed in the earlier paper.

Compared with the catfish which occupied this pool the preceding year (see Text-fig. 2), some curious differences and similarities appear. Sunfish nest 1 occupied exactly the same place as catfish nest 3. In other words, the first choice of the former was the last choice of the latter. The other two catfish nests occupied places in which sunfish would surely not be expected to nest, in a cavity and in a well-sheltered spot. This still leaves unexplained why the one catfish nested in such a sunfish-like manner—at a place which, as a matter of fact, was the first choice of the latter—a choice that might have been guessed on *a priori* grounds. In this connection it should be mentioned that the pool suffered from no limitation of presumably choice catfish nesting sites, but that they did nest as remote from each other as practicable. This wide selection of sites was not true in the case of the sunfish which were strictly limited as to suitable sites, and indeed the pool was a trifle too shaded to be ideal for such a species. Since the first catfish nest occupied a position near the central part of the "U" formed by the pool, the only thing that was left for the other two pairs was to retreat up each arm as far as other factors permitted. Compared with the order of selection exercised by the sunfish, which is indicated in the body of the paper, we actually have a similar type of centrifugal influence expressed in two very different kinds of nest building fishes. These sunfish nests compared with those

of Pines Lake (Breder, 1936) show thoroughly comparable selective reactions. The remaining data in the body of the paper are confirmatory of those in the earlier study.

SUMMARY.

1. Earlier studies on *Eupomotis* are confirmed under semi-controlled conditions.
2. A comparison is made between the nesting habits of *Eupomotis* and *Ameiurus* under identical conditions in which it is seen that the first choice of one was the last choice of the other.
3. The role of nesting males in pursuing females is indicated to be indicative of his presence and willingness to mate, rather than an overpowering effect.
4. Males may operate, intermittently, over two close nests.
5. Selection of nesting sites of *Eupomotis* and *Ameiurus* is shown to be controlled by a centrifugal influence between nesting individuals, modified by the limitations of the availability of suitable nesting sites.

REFERENCES.

BREDER, C. M., JR.

1936. The Reproductive Habits of the North American Sunfishes (Family Centrarchidae). *Zoologica* 21 (1): 1-48.
1939. Variations in the Nesting Habits of *Ameiurus nebulosus* (Le Sueur). *Zoologica* 24 (25): 367-378.

EXPLANATION OF THE PLATES.

PLATE I.

Nest 3 on May 25. See Table I. This nest was begun the day previous. It was impossible to photograph the nest groups, due to difficult lighting conditions and interfering vegetation.

PLATE II.

Nest 1 on June 5. See Table I. This shows the nest on the day after the first batch of eggs was laid.